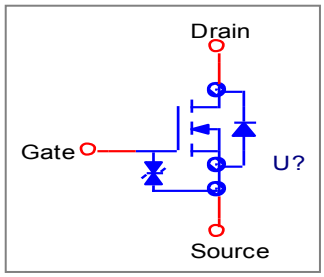
Device Modeling Report

COMPONENTS: MOSFET (Model Parameters)
PART NUMBER: 2SK3058
MANUFACTURER: NEC Corporation
REMARK: Body Diode (Model Parameters) /
ESD Protection Diode

Bee Technologies Inc.

Circuit Configuration

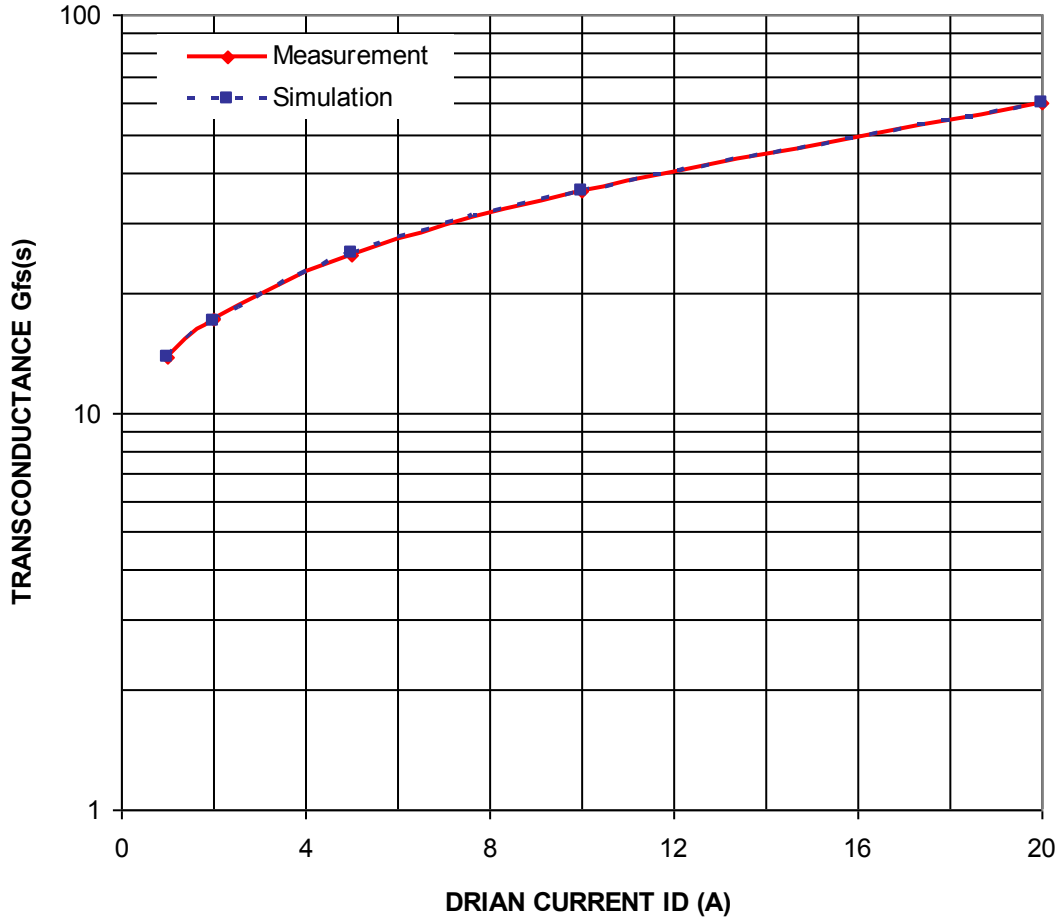


MOSFET MODEL

PSpice model parameter	Model description
LEVEL	
L	Channel Length
W	Channel Width
KP	Transconductance
RS	Source Ohmic Resistance
RD	Ohmic Drain Resistance
VTO	Zero-bias Threshold Voltage
RDS	Drain-Source Shunt Resistance
TOX	Gate Oxide Thickness
CGSO	Zero-bias Gate-Source Capacitance
CGDO	Zero-bias Gate-Drain Capacitance
CBD	Zero-bias Bulk-Drain Junction Capacitance
MJ	Bulk Junction Grading Coefficient
PB	Bulk Junction Potential
FC	Bulk Junction Forward-bias Capacitance Coefficient
RG	Gate Ohmic Resistance
IS	Bulk Junction Saturation Current
N	Bulk Junction Emission Coefficient
RB	Bulk Series Resistance
PHI	Surface Inversion Potential
GAMMA	Body-effect Parameter
DELTA	Width effect on Threshold Voltage
ETA	Static Feedback on Threshold Voltage
THETA	Modility Modulation
KAPPA	Saturation Field Factor
VMAX	Maximum Drift Velocity of Carriers
XJ	Metallurgical Junction Depth
UO	Surface Mobility

Transconductance Characteristics

Circuit Simulation Result

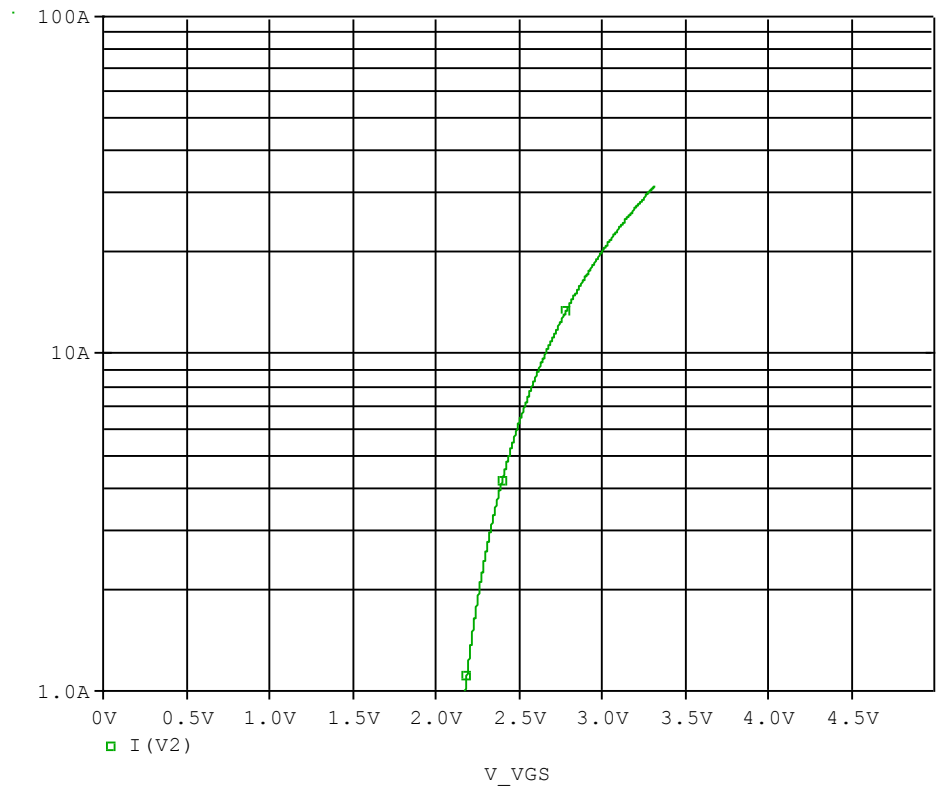


Comparison table

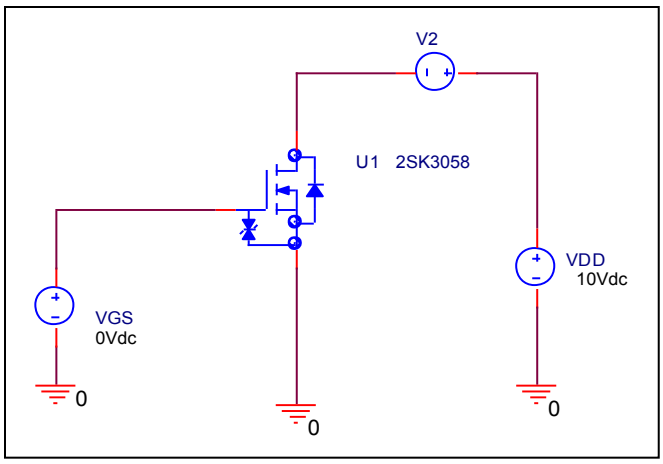
Id(A)	gfs(s)		Error(%)
	Measurement	Simulation	
1	13.6986	13.7800	0.5940
2	17.1253	17.0000	-0.7317
5	25.0000	25.1235	0.4942
10	36.0101	36.2158	0.5712
20	60.0000	59.8892	-0.1847

Vgs-Id Characteristics

Circuit Simulation Result

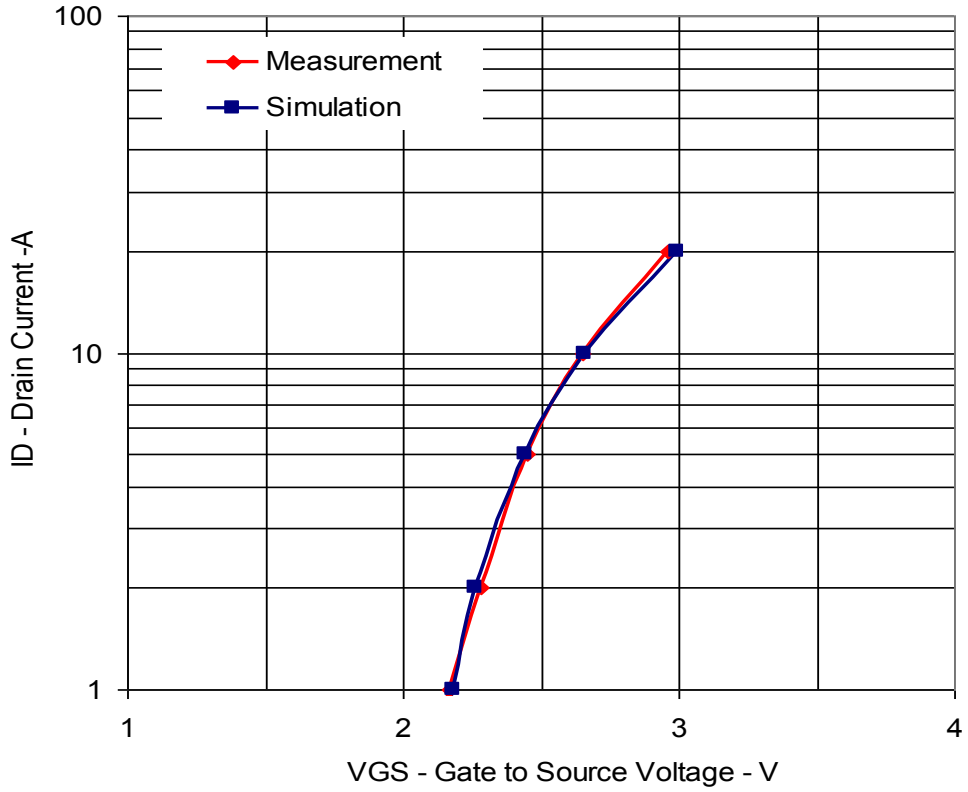


Evaluation circuit



Comparison Graph

Circuit Simulation Result

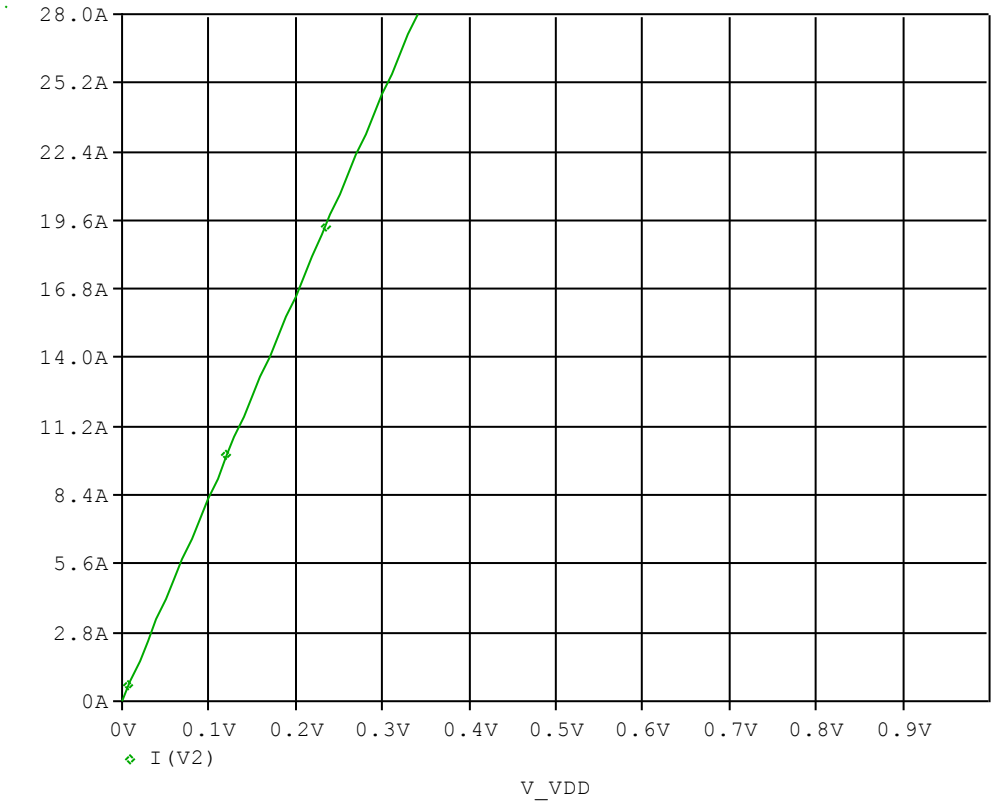


Comparison table

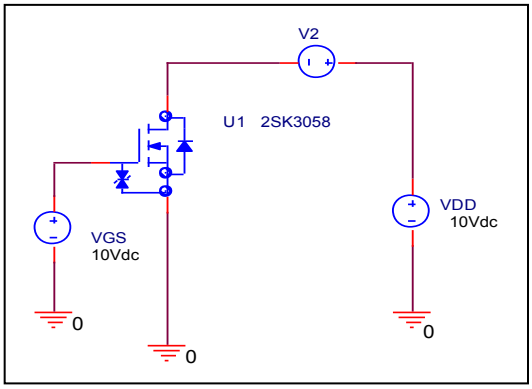
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
1	2.1700	2.1786	0.3963
2	2.2800	2.2633	-0.7325
5	2.4500	2.4426	-0.3020
10	2.6500	2.6609	0.4113
20	2.9600	2.9900	1.0135

*Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

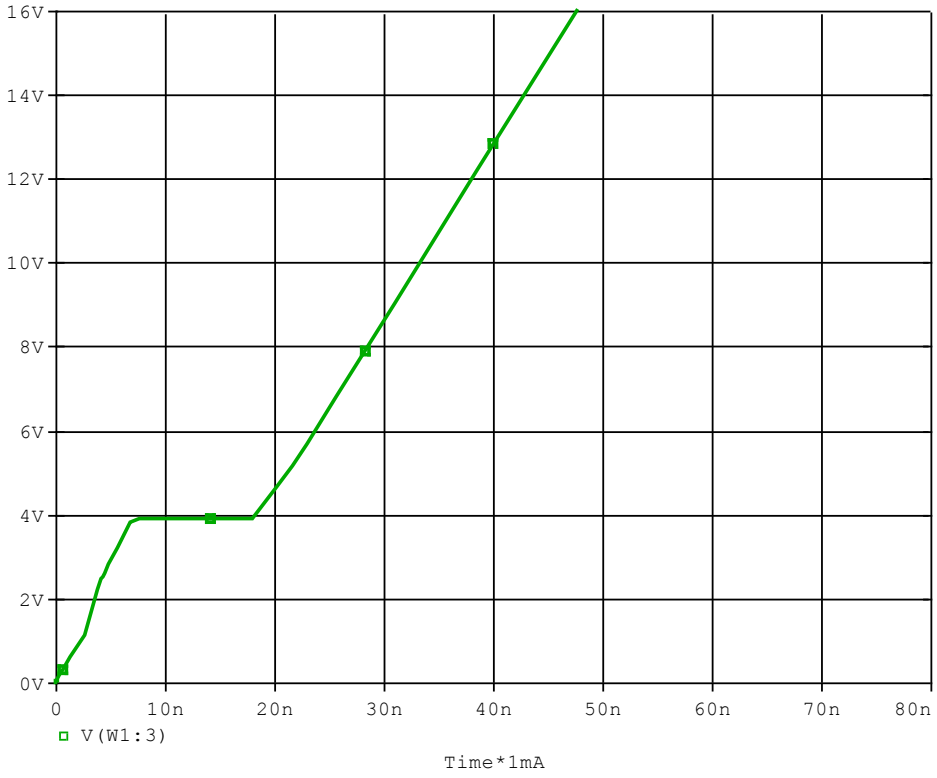


Simulation Result

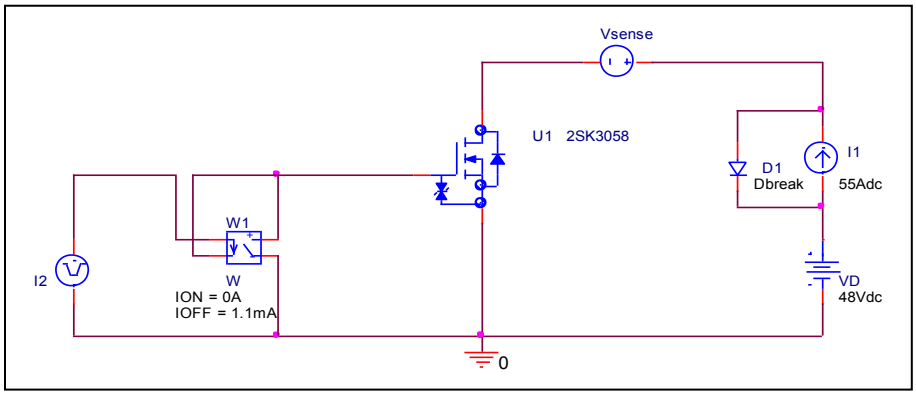
I_D=28A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	12.000	mΩ	12.017	mΩ	0.1416

Gate Charge Characteristic

Circuit Simulation result



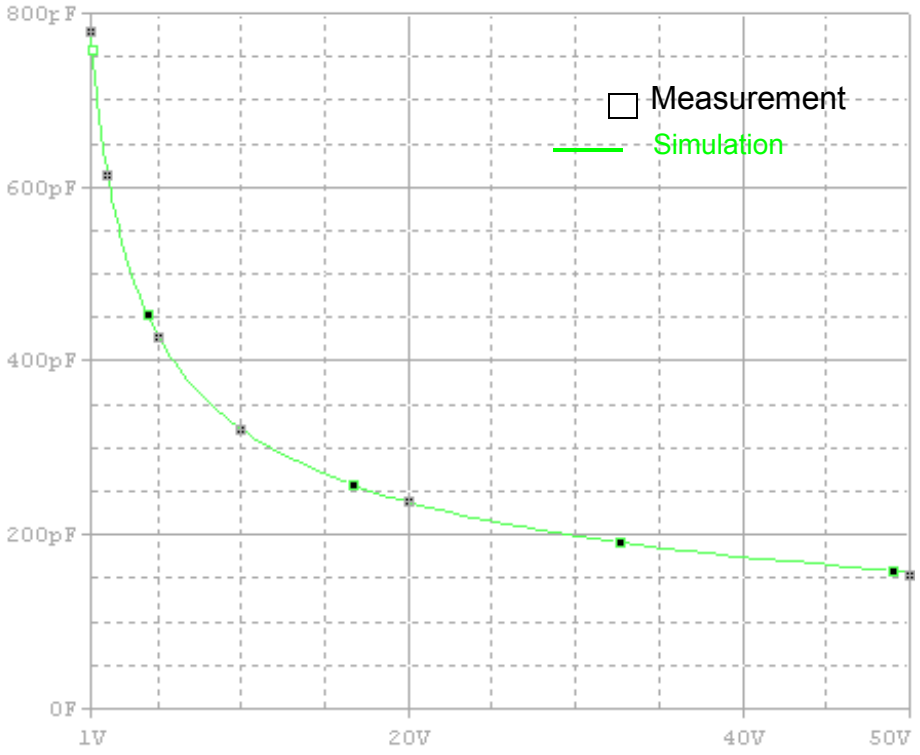
Evaluation circuit



Simulation Result

V_{DD}=48V,I_D=55A ,V_{GS}=10V	Measurement		Simulation		Error (%)
Qgs	7.00	nC	7.30	nC	4.2857
Qgd	18.00	nC	17.79	nC	-1.1610

Capacitance Characteristic

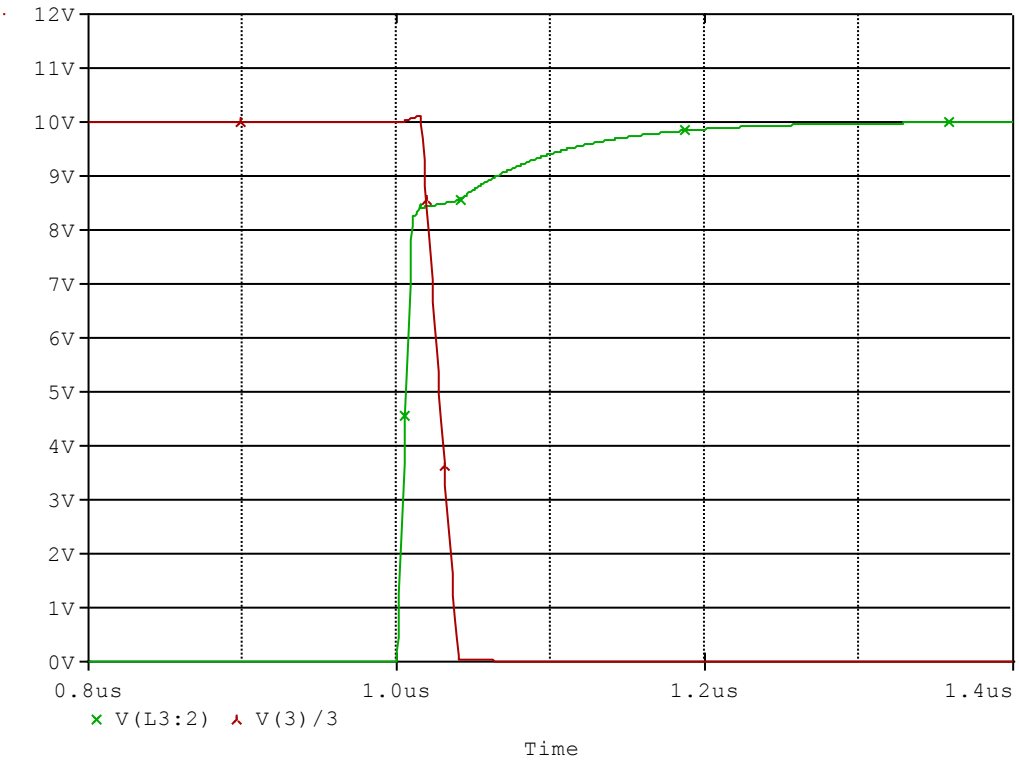


Simulation Result

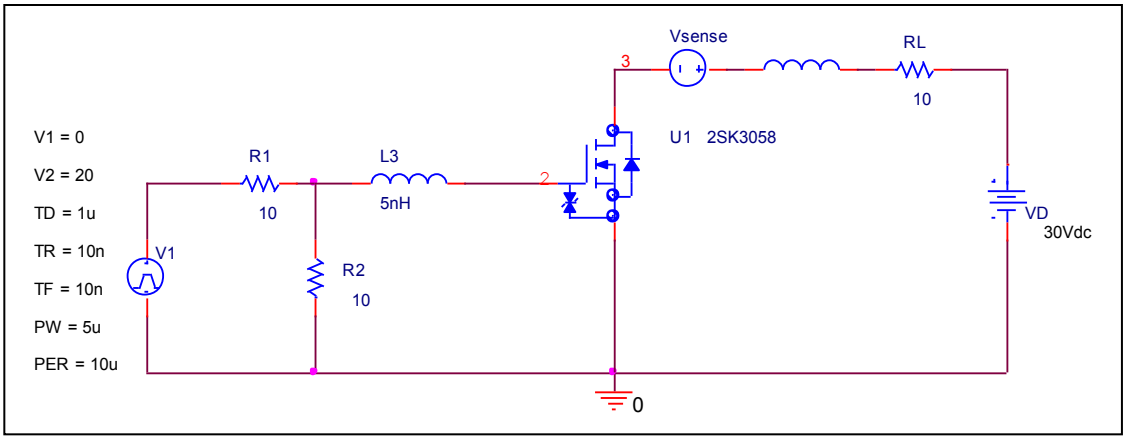
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
1	780.000	779.625	-0.048
2	610.000	615.899	0.967
5	420.000	430.794	2.570
10	330.000	321.183	-2.672
20	245.000	237.566	-3.034
50	150.000	158.466	5.644

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

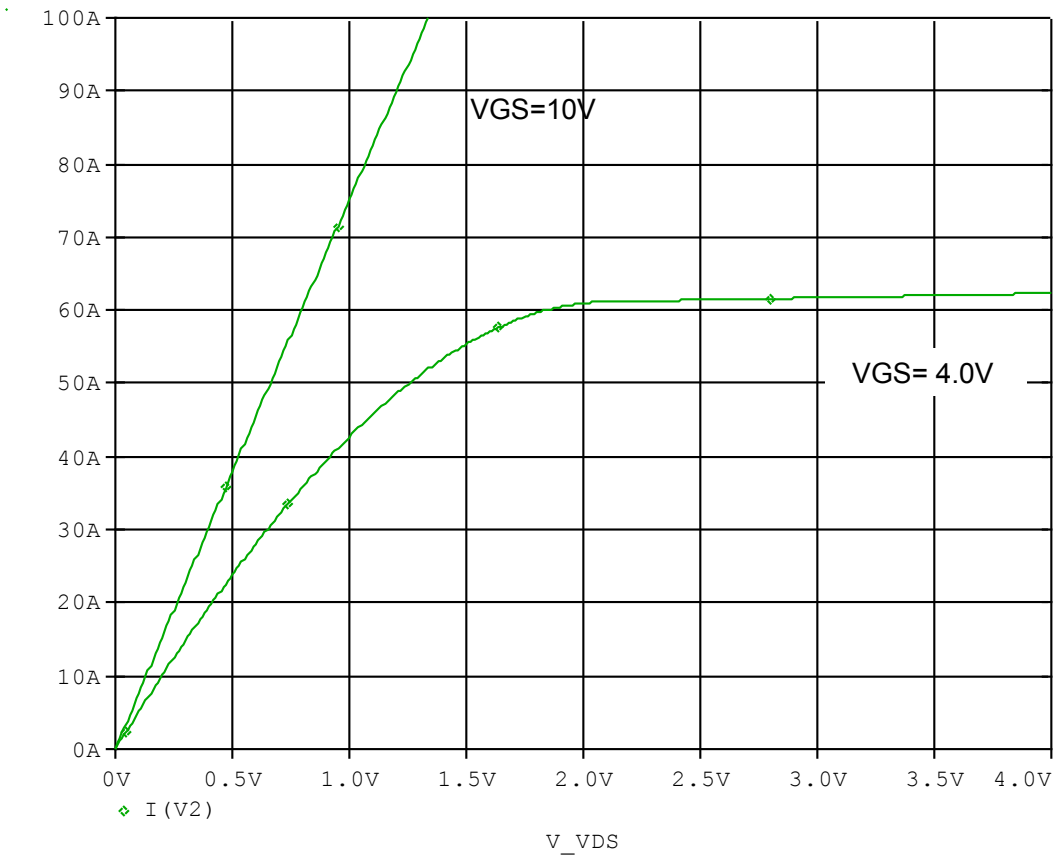


Simulation Result

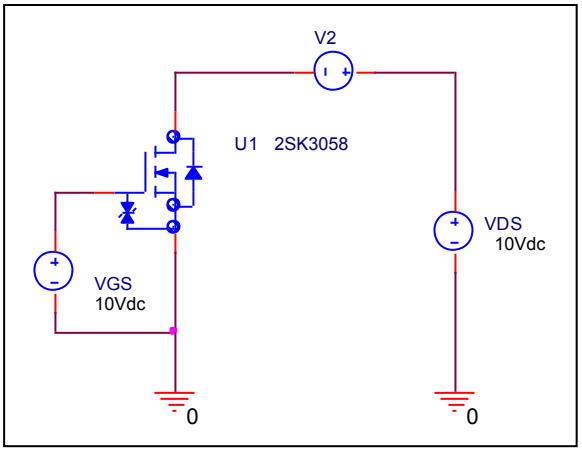
I_D=28A, V_{DD}=30V V_{GS}=0/10V	Measurement		Simulation		Error(%)
td (on)	36.000	ns	35.941	ns	-1.413

Output Characteristic

Circuit Simulation result

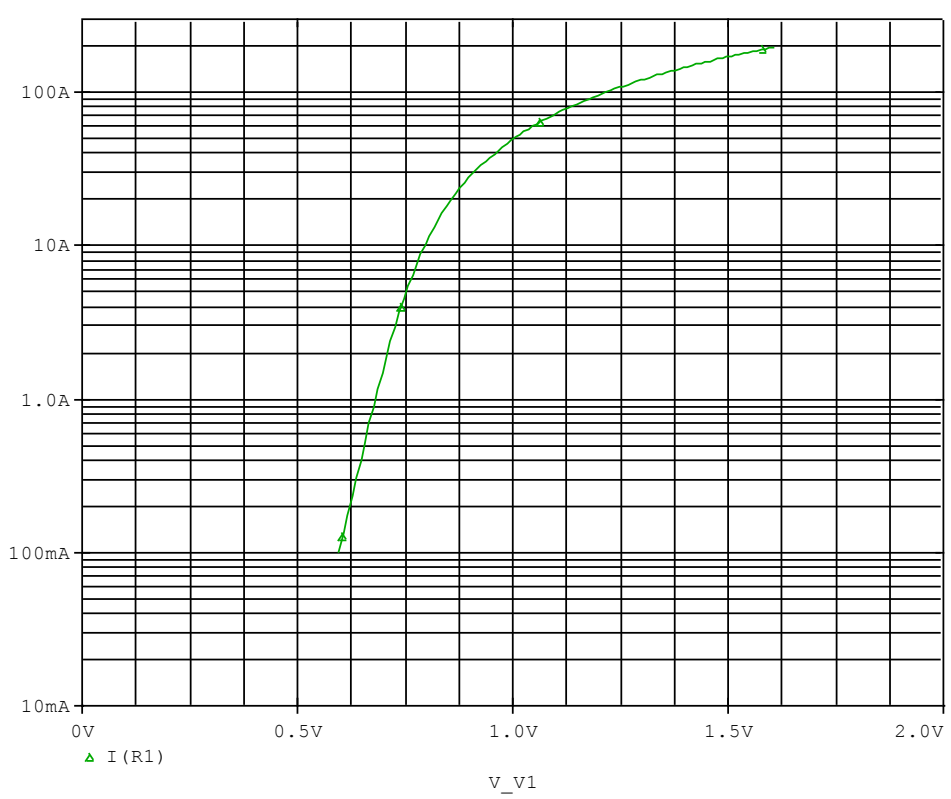


Evaluation circuit

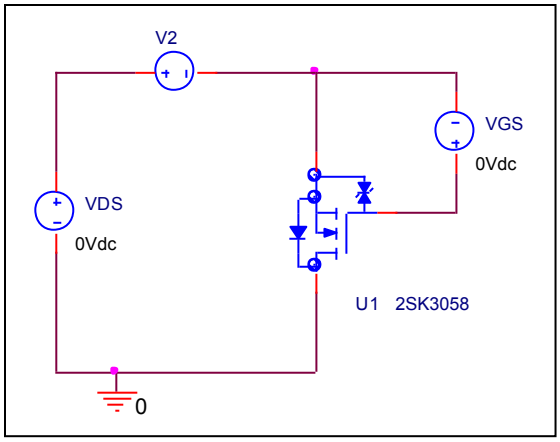


BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

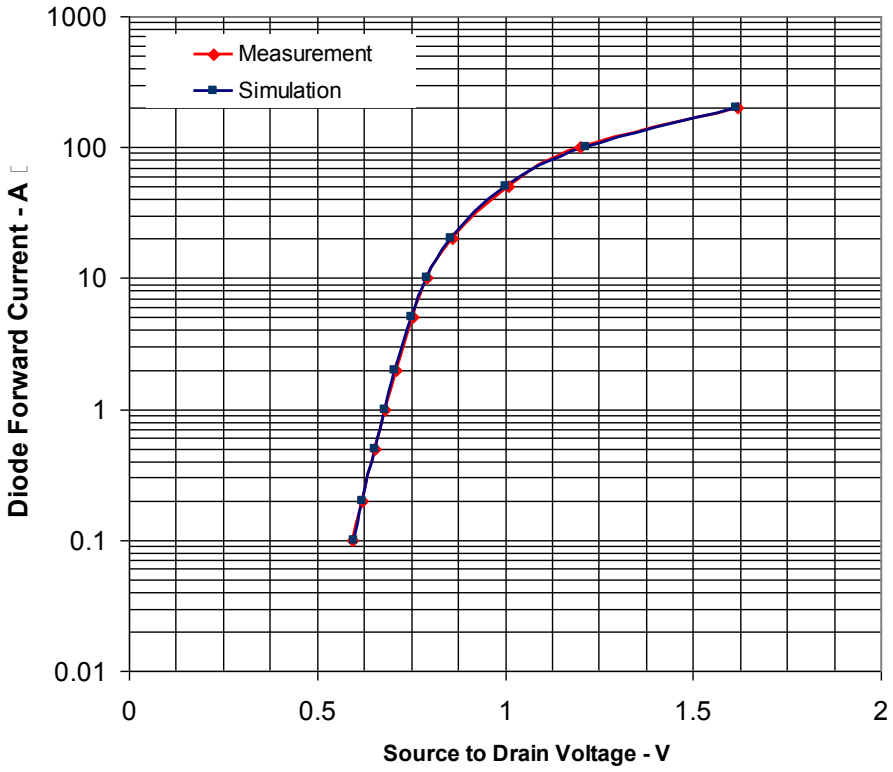


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

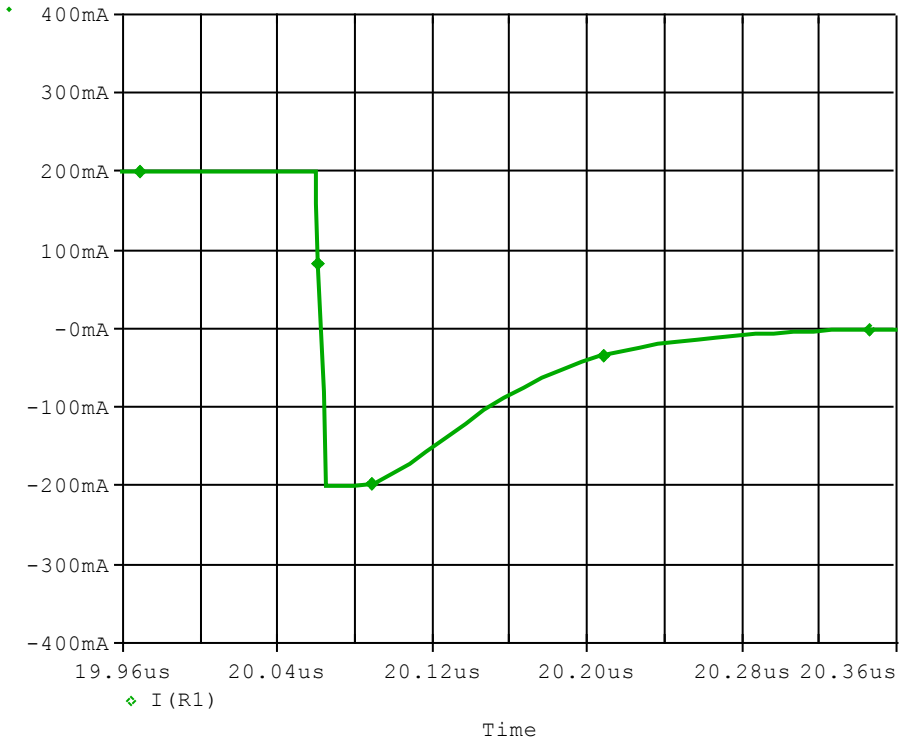


Simulation Result

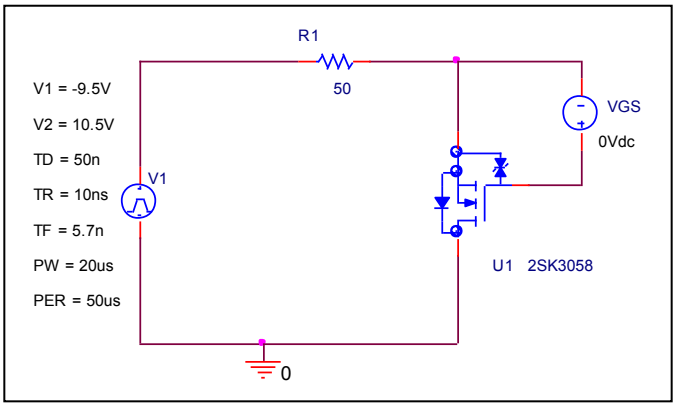
IDR(A)	VDS(V)		%Error
	Measurement	Simulation	
0.1	0.5950	0.5967	0.2857
0.2	0.6220	0.6211	-0.1447
0.5	0.6550	0.6546	-0.0611
1	0.6810	0.6804	-0.0881
2	0.7100	0.7084	-0.2254
5	0.7540	0.7515	-0.3316
10	0.7920	0.7936	0.2020
20	0.8600	0.8570	-0.3488
50	1.0100	1.0000	-0.9901
100	1.2000	1.2144	1.2000
200	1.6200	1.6144	-0.3457

Reverse Recovery Characteristic

Circuit Simulation Result



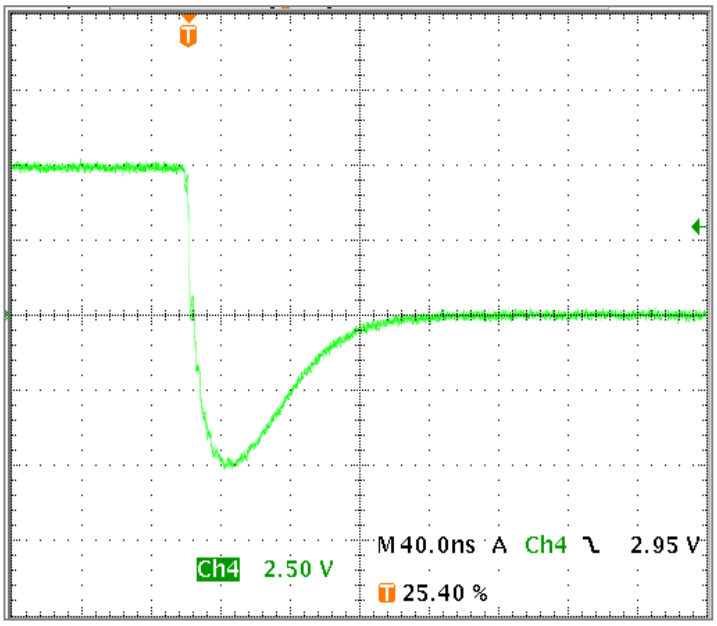
Evaluation Circuit



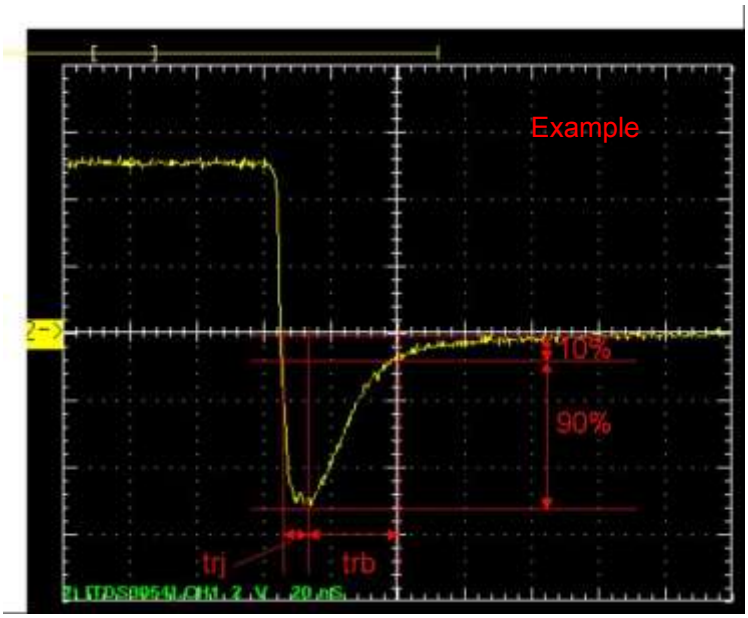
Compare Measurement vs. Simulation

	Measurement		Simulation		Error (%)
trj	**32.000**	**ns**	**31.988**	**ns**	**-0.0375**

Reverse Recovery Characteristic Reference



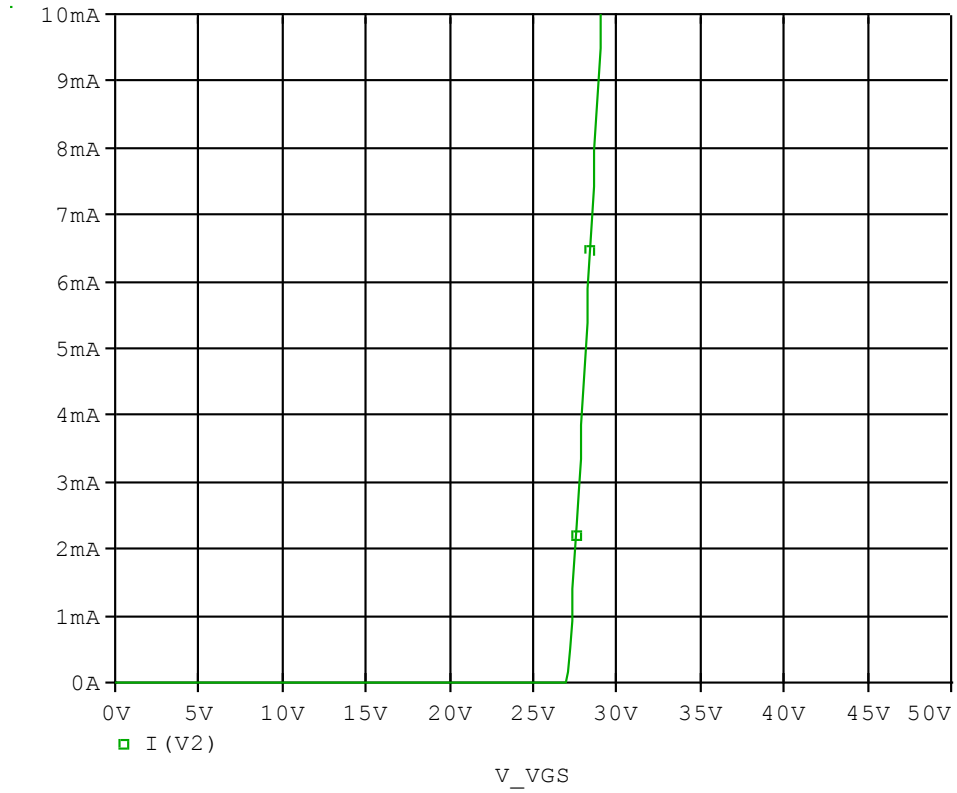
Trj=32(ns)
Trb=51(ns)
Conditions:Ifwd=0.2,Irev=0.2(A),Rl=50



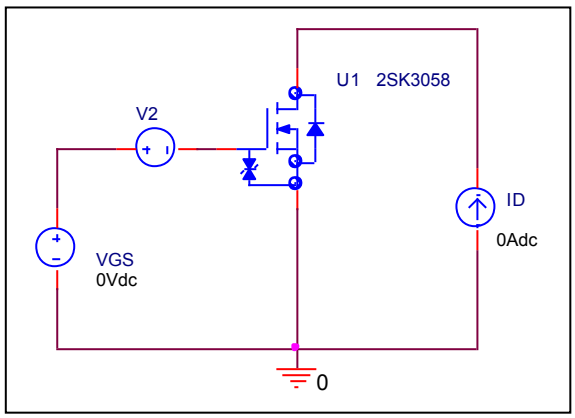
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference